

CLAIMS:

1. A safety device for a vehicle comprising:

a distance information detecting element for detecting a distance to a crash object and a relative speed relative to the crash object;

a passenger protection element for lightening crash damage by completing a transition to a passenger protecting state after a predetermined actuation rise time elapses from an actuation start time;

a calculation and control element for ordering a start of actuation with as the actuation start time the time at which an available time before crash that is the time to an estimated crash time calculated on the basis of the detected distance and relative speed falls to a predetermined first threshold time set to be equal to or longer than said actuation rise time; and

a deceleration rate information detecting element for detecting deceleration rate information relating to a deceleration rate that is a rate of change of said relative speed,

said calculation and control element corrects said actuation start time on the basis of said deceleration rate information.

2. A safety device for a vehicle according to claim 1, wherein said calculation and control element corrects said actuation start time on the basis of said deceleration rate information so that said actuation start time is made later

when said deceleration rate is high compared to when it is low.

3. A safety device for a vehicle according to claim 1, wherein said deceleration rate information detecting element detects at least one of a vehicle-driving operation of a vehicle driver and a vehicle state resulting from the vehicle-driving operation, and said calculation and control element obtains the deceleration rate information on the basis of at least one of said vehicle-driving operation and vehicle state resulting from the vehicle-driving operation.

4. A safety device for a vehicle according to claim 3, wherein said calculation and control element calculates an amount of change in at least one of said vehicle-driving operation and vehicle state resulting from the vehicle-driving operation, and obtains said deceleration rate information from said amount of change.

5. A safety device for a vehicle according to claim 3, wherein said deceleration rate information detecting element includes at least one among a brake depression sensor for detecting a depression amount of a brake pedal, a brake pressure sensor for detecting a brake pressure, an acceleration sensor for detecting the deceleration rate of the vehicle, a yaw rate sensor for detecting a yaw rate, and a steering angle sensor for detecting a steering angle.

6. A safety device for a vehicle according to claim 1, wherein said calculation and control element corrects said actuation start time on the basis of the deceleration rate information detected by said deceleration rate information

detecting element, during a time period from when said available time before crash reaches a second threshold time longer than said first threshold time to when it reaches said first threshold time.

7. A safety device for a vehicle according to claim 1, wherein said passenger protection element is a seat belt reeling-in device.

8. A safety device for a vehicle comprising:

a distance information detecting element for detecting a distance to a crash object and a relative speed relative to the crash object;

a passenger protection element for lightening crash damage by completing a transition to a passenger protecting state after a predetermined actuation rise time elapses from an actuation start time;

a calculation and control element for ordering a start of actuation with as the actuation start time the time at which an available time before crash that is the time to an estimated crash time calculated on the basis of the detected distance and relative speed falls to a predetermined first threshold time set to be equal to or longer than said actuation rise time, and for ordering a stop of actuation with as an actuation stop time the time advancing by a predetermined third threshold time from said estimated crash time; and

a deceleration rate information detecting element for detecting deceleration rate information relating to a deceleration rate that is a rate of change of said relative

speed,

said calculation and control element corrects said actuation stop time on the basis of said deceleration rate information.

9. A safety device for a vehicle according to claim 8, wherein said calculation and control element corrects said actuation stop time on the basis of said deceleration rate information so that said actuation stop time is made earlier when said deceleration rate is low compared to when it is high.

10. A safety device for a vehicle according to claim 8, wherein said deceleration rate information detecting element detects at least one of a vehicle-driving operation of a vehicle driver and a vehicle state resulting from the vehicle-driving operation, and said calculation and control element obtains the deceleration rate information on the basis of at least one of said vehicle-driving operation and vehicle state resulting from the vehicle-driving operation.

11. A safety device for a vehicle according to claim 10, wherein said calculation and control element calculates an amount of change in at least one of said vehicle-driving operation and vehicle state resulting from the vehicle-driving operation, and obtains said deceleration rate information from said amount of change.

12. A safety device for a vehicle according to claim 10, wherein said deceleration rate information detecting element includes at least one among a brake depression sensor for detecting a depression amount of a brake pedal, a brake pressure

sensor for detecting a brake pressure, a acceleration sensor for detecting the deceleration rate of the vehicle, a yaw rate sensor for detecting a yaw rate, and a steering angle sensor for detecting a steering angel.

13. A safety device for a vehicle according to claim 8, wherein said calculation and control element corrects said actuation stop time on the basis of the deceleration rate information detected by said deceleration rate information detecting element, during a time period from when said available time before crash reaches a second threshold time longer than said first threshold time to when it reaches said first threshold time.

14. A safety device for a vehicle according to claim 8, wherein said passenger protection element is a seat belt reeling-in device.

15. A safety device for a vehicle according to claim 8, wherein said calculation and control element corrects said actuation start time on the basis of said deceleration rate information, and calculates said actuation stop time by adding the corrected actuation start time to a predetermined actuation time of said passenger protection element.

16. A safety device for a vehicle comprising:

a distance information detecting element for detecting a distance to a crash object and a relative speed relative to the crash object;

a passenger protection element for lightening crash damage by completing a transition to a passenger protecting

state after a predetermined actuation rise time elapses from an actuation start time;

a calculation and control element for ordering a start of actuation with as the actuation start time the time at which an available time before crash that is the time to an estimated crash time calculated on the basis of the detected distance and relative speed falls to a predetermined first threshold time set to be equal to or longer than said actuation rise time; and

a deceleration rate information detecting element for detecting deceleration rate information relating to a deceleration rate that is a rate of change of said relative speed,

said calculation and control element adjusts a strength of a protection actuation of said passenger protection element on the basis of said deceleration rate information.

17. A safety device for a vehicle according to claim 16, wherein said calculation and control element adjusts the strength of the protection actuation on the basis of said deceleration rate information so as to make the protection actuation of the passenger protection element stronger when the deceleration rate is high compared to when it is low.

18. A safety device for a vehicle according to claim 16, wherein said passenger protection element is a seat belt reeling-in device, and said calculation and control element adjusts the strength of the protection actuation by changing a tension of a seat belt.

19. A safety device for a vehicle according to claim 16, wherein said deceleration rate information detecting element detects at least one of a vehicle-driving operation of a vehicle driver and a vehicle state resulting from the vehicle-driving operation, and said calculation and control element obtains the deceleration rate information on the basis of at least one of said vehicle-driving operation and vehicle state resulting from the vehicle-driving operation.

20. A safety device for a vehicle according to claim 19, wherein said calculation and control element calculates an amount of change in at least one of said vehicle-driving operation and vehicle state resulting from the vehicle-driving operation, and obtains said deceleration rate information from said amount of change.

21. A safety device for a vehicle according to claim 19, wherein said deceleration rate information detecting element includes at least one among a brake depression sensor for detecting a depression amount of a brake pedal, a brake pressure sensor for detecting a brake pressure, an acceleration sensor for detecting the deceleration rate of the vehicle, a yaw rate sensor for detecting a yaw rate, and a steering angle sensor for detecting a steering angle.

22. A safety device for a vehicle according to claim 16, wherein said calculation and control element adjusts the protection actuation of said passenger protection element on the basis of the deceleration rate information detected by said deceleration rate information detecting element, during a time

period from when said available time before crash reaches a second threshold time longer than said first threshold time to when it reaches said first threshold time.

23. A safety device for a vehicle comprising:

a distance information detecting element for detecting a distance to a crash object and a relative speed relative to the crash object;

a passenger protection element for lightening crash damage by completing a transition to a passenger protecting state after a predetermined actuation rise time elapses from an actuation start time; and

a calculation and control element for ordering a start of actuation with as the actuation start time the time at which an available time before crash that is the time to an estimated crash time calculated on the basis of the detected distance and relative speed falls to a predetermined first threshold time set to be equal to or longer than said actuation rise time; and

said calculation and control element actuates said passenger protection element so as to make the actuation rise time shorter when said available time before crash is short compared to when it is long.

24. A safety device for a vehicle according to claim 23, wherein said calculation and control element determines a length of said available time before crash depending on whether or not an available time to said actuation start time is equal to or longer than a predetermined fourth threshold time.



25. A safety device for a vehicle according to claim 24, wherein said predetermined fourth threshold time is set to a positive value including 0.

26. A safety device for a vehicle according to claim 23, wherein said passenger protection element is a seat belt reeling-in device, and said calculation and control element adjusts said actuation rise time by changing a reeling-in speed of a seat belt.

27. A safety device for a vehicle according to claim 23, further comprising a deceleration rate information detecting element for detecting deceleration rate information relating to a deceleration rate that is a rate of change of said relative speed, and wherein said calculation and control element adjusts said actuation rise time on the basis of said deceleration rate information.

28. A safety device for a vehicle according to claim 27, wherein said calculation and control element adjusts said actuation rise time on the basis of said deceleration rate information so as to make said actuation rise time shorter when said deceleration rate is high compared to when it is low.

29. A safety device for a vehicle according to claim 27, wherein said deceleration rate information detecting element detects at least one of a vehicle-driving operation of a vehicle driver and a vehicle state resulting from the vehicle-driving operation, and said calculation and control element obtains the deceleration rate information on the basis of at least one of said vehicle-driving operation and vehicle state resulting

from the vehicle-driving operation.

30. A safety device for a vehicle according to claim 29, wherein said calculation and control element calculates an amount of change in at least one of said vehicle-driving operation and vehicle state resulting from the vehicle-driving operation, and obtains said deceleration rate information from said amount of change.

31. A safety device for a vehicle according to claim 29, wherein said deceleration rate information detecting element includes at least one among a brake depression sensor for detecting a depression amount of a brake pedal, a brake pressure sensor for detecting a brake pressure, an acceleration sensor for detecting the deceleration rate of the vehicle, a yaw rate sensor for detecting a yaw rate, and a steering angle sensor for detecting a steering angle.